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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/986,332

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Hiroyuki Kiyoku

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09/25/2003

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EXAMINER

ANDERSON, MATTHEW A

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 09/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/986,332

Applicant(s)

KIYOKU ET AL.

Examiner

Matthew A. Anderson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 June 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 208-233 is/are pending in the application.
- 4a) Of the above claim(s) 221-233 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) 1 and 208-220 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 November 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☒ Certified copies of the priority documents have been received in Application No. 09/202,141.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 8 9/8/03
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 208-213, 215, 217-220 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka et al. (WO 97/11518) in view of Takeuchi et al. (US 5,239,188).

The examiner has used the disclosure of US 6,377,596 B1 as a translation of the PCT publication.

Tanaka et al. discloses a method for growing a low defect monocrystalline defect monocrystalline layer over a mask. The method is described as forming light emitting diodes in col. 1 lines 15-25. In Fig. 16 and in col. 28 lines 34+ the method is described. Striped openings in a insulator mask are formed on the (0001) plane of a sapphire substrate. (in col. 19 lines 65 is suggested that such stripes be formed in the direction parallel to the (11-20) A plane of a sapphire substrate. Perpendicular stripes to the (11-20) plane are also disclose in col. 11 line 55.) A GaN buffer layer is formed in the spaces between the stripes. N-

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type GaN is grown from the spaces laterally until it covers the mask between them (i.e. coalesces). The growth is described as by MOVPE. The defect density obtained is disclosed in col. 32 as 10^4 to 10^5 defects per cm^2 . MOVPE is described in col. 17 and 18 in which a tri-methyl gallium is reacted with ammonia to form the GaN. The substrate is disclosed as sapphire (Al_2O_3) or SiC. The insulator making up the mask was disclosed in col. 5 lines 65+ and col. 6 lines 1-5 as amorphous material such as SiO_2 , Si_3N_4 , PSG, SION, or Ta_2O_3 . The relative size of the spaces is seen in Fig. 16 B to less than that of the mask layers. Multiple iterations of growth and mask layer formation are suggested in Figs. 16a-16c and 18a-18c. Further, and active layer (6) is grown on the second nitride semiconductor (5) as seen in Fig. 18C.

Takeuchi et al. discloses a gallium nitride base semiconductor device. In Fig. 4A,4B,4C, and 4D is shown a epitaxial overgrowth of GaN on a Si substrate using a AlN mask layer. In Col. 3 lines 35-50, it is disclosed that the nitride semiconductor will also deposit on a thin AlN buffer layer on a sapphire substrate. In Fig. 3 is shown a n-GaN single crystal. In Fig. 4C is seen the growth of GaN from the sides of the recesses in the overlying AlN layer.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the disclosures of the references cited to yield a method of forming a gallium nitride semiconductor as disclosed in Claim 1 because the use of nitride buffer layers (i.e. a nitride underlayer) on a sapphire substrate to reduce defects and the use of mask layers for epitaxial overgrowth and recombination where known in the art.

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It would have been obvious to one of ordinary skill in the art at the time of the present invention to form a nitride semiconductor as disclosed in Claims 1, 208, 211 because the use of nitride buffer layers (i.e. a nitride underlayer) on a sapphire substrate to reduce defects and the use of mask layers for epitaxial overgrowth and recombination were known in the art to produce nitride semiconductors with reduced defect densities.

In respect to claim 1, it would have been obvious to one of ordinary skill in the art at the time of the present invention to optimize the process parameters of crystallographic orientation of the sapphire substrate and the direction in which the mask stripes extend because the (11-20) and the (1-120) planes were known in the art and such optimization would have been achieved with routine experimentation. The examiner notes that no evidence of unexpected results or evidence that no growth occurs on the different known planes has been presented counter to this.

In respect to claims 208, 209, 210, 217-220, it would have been obvious to one of ordinary skill in the art at the time of the present invention to use multiple iterations of mask layers, position the second mask over the windows in the first mask, and to grow the first and second nitride semiconductors laterally on the growth masks because Tanaka et al. suggests this in Figs. 16 and 18.

In respect to claim 212, it would have been obvious to one of ordinary skill in the art at the time of the present invention to grow light emitting diodes by this method because Tanaka et al. suggests this very use in col. 1 lines 15-25.

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In respect to claim 213, it would have been obvious to one of ordinary skill in the art at the time of the present invention to include indium in the nitride semiconductor being grown because Tanaka et al. suggests this in col. 23 lines 35-50.

In respect to claim 215, it would have been obvious to one of ordinary skill in the art to dope the first nitride semiconductor with an n-type impurity because such a doping was known in the art (Takeuchi et al.).

3. Claims 214, 216 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tanaka in view of in view of Takeuchi et al., and further in view of Tischler et al.(US 5,679,152).

Tanaka combined is disclosed above.

Tanaka combined does not explicitly suggest using a superlattice buffer layer on the nitride substrate formed or Si doping to form n-type nitrides.

Tischler et al. discloses in column 4 lines 35-50 an alternately layered nitride superlattice to reduce the dislocation defects in a GaN crystals and alloys thereof. N-type GaN is disclosed as formed from Si additions in col. 8 lines 60+.

It would have been obvious to one of ordinary skill in the art at the time of the present invention to combine the superlattice of Tischler et al. with Tanaka combined because then one of ordinary skill would have expected the product crystal to have fewer defects.

In respect to claim 214, it would have been obvious to one of ordinary skill in the art at the time of the present invention to form a buffer layer as claimed

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because such would have been expected to improve the nitride semiconductor grown thereon.

In respect to claim 216, it would have been obvious to one of ordinary skill in the art at the time of the present invention to form n-type nitrides with Si doping because such was known in the art (i.e. by Tischler et al.).

Response to Arguments

4. Applicant's arguments filed /18/2003 have been fully considered but they are not persuasive.

The argument that there was no motivation to use other crystal planes as the major surface are not convincing. Those of ordinary skill would have expected other orientations to produce growth albeit at different growth rates. The examiner notes that the (11-20) is a plane in the hexagonal system.

Election/Restrictions

5. Newly submitted claims 221-233 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: The applicant elected without traverse to Group I drawn to method in paper 5.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original

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presentation for prosecution on the merits. Accordingly, claims 221-233 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew A. Anderson whose telephone

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number is (703) 308-0086. The examiner can normally be reached on M-Th, 6:30-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (703) 305-2667. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

MAA
September 8, 2003

NADINE G. NORTON
PRIMARY EXAMINER

